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Long-run stock price-house price relation: evidence from an ESTR model

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Abstract

The direction of any long-run relationship between stock prices and house prices provides useful information for policy makers and practitioners regarding the presence of wealth and credit effects. Using quarterly data from the UK and US this paper reports evidence of non-linear dynamics in the adjustment to equilibrium. Specifically, the equilibrium-deviation must become large before stock prices revert. However, there is no evidence that house price adjust to any disequilibrium. This supports a credit effect on stock prices.

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1. Introduction.

The rollercoaster ride that both house prices and stock prices have been on for the past twenty years opens up the important question of what is the nature of the relationship between these two prices.[1] In particular, do they exhibit a common long-run trend or to what extend does one price change affect the other. Moreover, given that the markets necessarily adjust at different speeds we allow for the possibility of a non-linear relationship. Understanding whether a causal relationship exists between these prices has obvious implications for policy-makers when faced with price bubbles, for example, and for practitioners, in attempting to forecast the movements of these assets. In particular, movements in the stock and housing markets can, in turn, have implications for consumption and the macroeconomy (e.g., Paiella, 2008). Thus, understanding the linkages between these markets is important. The aim of this note is to examine the nature of the relationship between house prices and stock price for the US and UK markets. Furthermore, while there exists evidence of non-linear behaviour within stock and housing markets separately (e.g., Guidolin et al, 2009; Kim and Bhattacharya, 2009), there is little evidence examining a non-linear relationship between them (exceptions include Okunev and Wilson, 1997; Okunev et al, 2000; Su, 2011; Su et al, 2011).

2. Why should they move together?

A relationship between house prices and stock prices could arise from both wealth and credit effects. Moreover, both assets can be viewed as investment alternatives, while, of course, housing is also a consumption good. A wealth effect could arise such that it would imply causality running from the stock market to the housing market. In particular, an unexpected gain in stock prices would lead to an increase in the (relative) share of stocks in an investment portfolio and wealth and could motivate households to rebalance their portfolios by investing in or consuming more housing.[2] In contrast, a credit effect implies a causal relationship running from house prices to stock prices. Here rising house prices (and more widely all real estate) can act as a form of collateral to credit-constrained households and firms. This can lead to an increase in consumption from households and an increase in investment from firms. Both the increase in consumption and the increase in investment may ultimately lead to an increase in stock prices (through increased expected future earnings from greater demand and firm efficiency). This therefore, in turn can fuel a round of wealth effects arising from higher stock prices and an upwards price spiral for both stocks and housing could occur.[3]

Furthermore, the nature of the relationship between stock prices and house prices may be non-linear. Such a relationship could exist for a couple of reasons. First, if we view the two assets as alternative investments, then small divergence from a long-run relationship would not cause investors to change portfolio holding due to transaction costs. Hence, we would expect equilibrium reversion to occur only once a sufficiently large deviation has occurred. Second, as liquidity in the housing market is generally a concern and more so than in the stock markets, investors may delay changing position to avoid transitory shifts in prices. Such, behaviour may cause non-linearity in the stock price-house price relation

[1] Early research reported small and often negative correlations in the returns of these two assets, see for example, Ibbotson and Siegel (1984) for the US and .Worzala and Vandell (1993) for the UK.

[2] Evidence for a wealth effect has been reported by Chen (2001) for Taiwan, Sutton (2002) for six developed markets, Kakes and van den End (2004) for the Netherlands, Abelson et al (2005) for Australia, Kapopoulos and Siokis (2005) for Greece and Ibrahim (2010) for Thailand.

[3] Evidence for a credit effect has been reported by Sim and Chang (2006) for Korea.

whereby their response to each other may be governed by the distance from any equilibrium position. An exponential smooth transition (ESTR) model can model this type of relationship

3. Data and Cointegration Tests.

For the UK and US, quarterly stock market and house price data is taken over the period from 1974 to 2009. The stock price data is the FT-ALL share index and the S&P500, while the house price data is from the Nationwide for the UK and from the Census Bureau for the US.[4] Figure 1 plots the data. To test whether there exists a long-run equilibrium between the stock price and house price series we conduct the usual Engle-Granger procedure for linear cointegration and the Kapetanios et al (2006) procedure for non-linear cointegration. In short, after estimating the cointegrating vector, we estimate:

$$\Delta z_t = \beta z_{t-1} + \varepsilon_t \quad (1)$$

$$\Delta z_t = \beta z_{t-1}^3 + \varepsilon_t \quad (2)$$

where z_t is the residual from the long-run cointegrating equation.

Table 1 presents the unit root tests for the series individually as well as the tests for cointegration. Evident from this table is that, as expected, the four price series all have a unit root. In addition, based on linear cointegration, neither the UK nor the US stock price-house price series exhibits such a relationship (although marginal evidence is stronger for the US, 12% significance). However, based on the ESTR tests, then both the UK and US exhibit non-linear cointegration. This broadly supports the results in Okunev and Wilson (1997), who also only report integration when viewed from a non-linear perspective.

4. Error-Correction Models.

Given the evidence of possible linear and probable non-linear cointegration in the above section, we now proceed to estimate the attendant error-correction models. We include (for completeness) a linear model for the UK even though the above results indicated that the series may not exhibit linear cointegration. Hence, the regression may not be balanced and the results should be interpreted with caution. While the form of the linear error-correction model is well-known the ESTR model is given as:

$$\Delta x_{i,t} = (\alpha_0 + \beta_i \Delta x_{i,t-1} + \gamma z_{t-1}) + (\gamma_{ESTR} z_{t-1}) * (1 - \exp(-\gamma z_{t-1}^2)) + \varepsilon_t \quad (3)$$

where $x_{i,t}$ refer to the stock price and house price series and z_t is the error-correction term. Experimentation was undertaken with including all parameters in the non-linear part of the equation; however, results were qualitatively similar to those reported.

Table 2 presents the error-correction models. Evident from the linear regressions is that for the house price series there is first-order autocorrelation but otherwise all parameters are insignificant, with no equilibrium-reverting behaviour or short-run causality from stock returns. Of interest, for the UK this autocorrelation is positive, while for the US the autocorrelation is negative. For the stock return series there is some evidence of long-run causality from house prices with a significant error-correction term, although for the UK the term is marginal (again noting the above caveat). Further, there is evidence of short-run causality from house price changes to stock returns for the US. With respect to the ESTR models, we see greater evidence of causality from house price to stock prices across both

[4] Some experimentation was undertaken with data from the Halifax for the UK and from the Federal Housing Finance Agency for the US. All results are qualitatively similar.

markets. More specifically, while the house price series continue to appear exogenous with only an autoregressive effect. That is, the lagged stock return and error-correction terms are statistically insignificant. For stock prices, the results for both the UK and US series now concur in that reversion to equilibrium only takes place in the outer regime of the ESTR model, while the inner regime is characterised by a random walk. Furthermore, we can see that the outer regime ESTR speed of adjustment is noticeably quicker than that reported in the linear model.

Our results therefore support the credit effect whereby rising house prices can cause a rise in stock prices but this only occurs once the disequilibrium caused by the increase in house prices becomes large, upon which stock prices move to restore equilibrium. Using a threshold model (which assumes an abrupt as opposed to smooth transition between regimes), the credit effect is also reported for the UK by Su (2011) and Su et al, (2011), who also report a similar finding for the Netherlands in both papers (and Germany in the former paper), but greater evidence of a wealth effect for Belgium in both papers (and Italy in the former paper) and feedback effects for France and Spain in both papers (and Switzerland in the former paper).

With respect to the US, Okunev et al, (2000) use linear and non-linear Granger causality tests to examine the relationship between the stock and real estate markets. They report linear causality from the real estate market but non-linear causality from the stock market and thus, in the non-linear aspect, differ from the results here. This difference may arise due to differences in the sample period, data or methodology employed between the paper of Okunev et al, (2000) and this one. More specifically, the current paper extends the time period analysed by eleven years and uses house price data as opposed to real estate investment trust data considered in Okunev et al, (2000). Finally, Okunev et al, (2000) employ non-linear Granger causality tests on the stationary returns, whereas this paper considers non-linear reversion around the long-run equilibrium. Nonetheless, further work will be required to provide a robust understanding of the nature of the relationship between US house and stock prices.

5. Summary and Conclusion.

The relationship between house prices and stock prices is an important one that has taken on greater significance over the past decade or so given the extreme movements in both. Understanding the nature of the relationship and any causal behaviour between the series is important for policy-makers who need to know how a bubble or wild swings in one market will affect the other. Equally, for market participants if a causal relationship exists then knowledge of one market could help predict the other.

Our results for the UK and US suggest that there does exist a long-run cointegrating relationship between stock prices and house prices if we allow for a non-linear dynamic in the speed of equilibrium reversion. From a linear perspective, cointegration is only (very marginally) supported in the US case. Furthermore, for both markets the non-linear cointegration implies that the speed of mean reversion increases with the distance from equilibrium. Perhaps more pertinently our results suggest that the direction of causality between these series is one-way running from house prices to stock prices both in the long-run for both markets and also in the short-run for the US. This supports a credit effect whereby rising house prices can enable previously credit-constrained households and firms to increase consumption and investment, leading to a rise in stock prices. Previous work has also reported a credit effect for the UK. The implications of our results suggest that when house prices experience a bubble (either positive or negative), such that the relationship with stock prices will move in to a position of large disequilibrium, then this will impact upon stock prices, who then may experience their own large price movements. This suggests the need to cool house prices in a rising market and support them in a falling market through appropriate policy tools.

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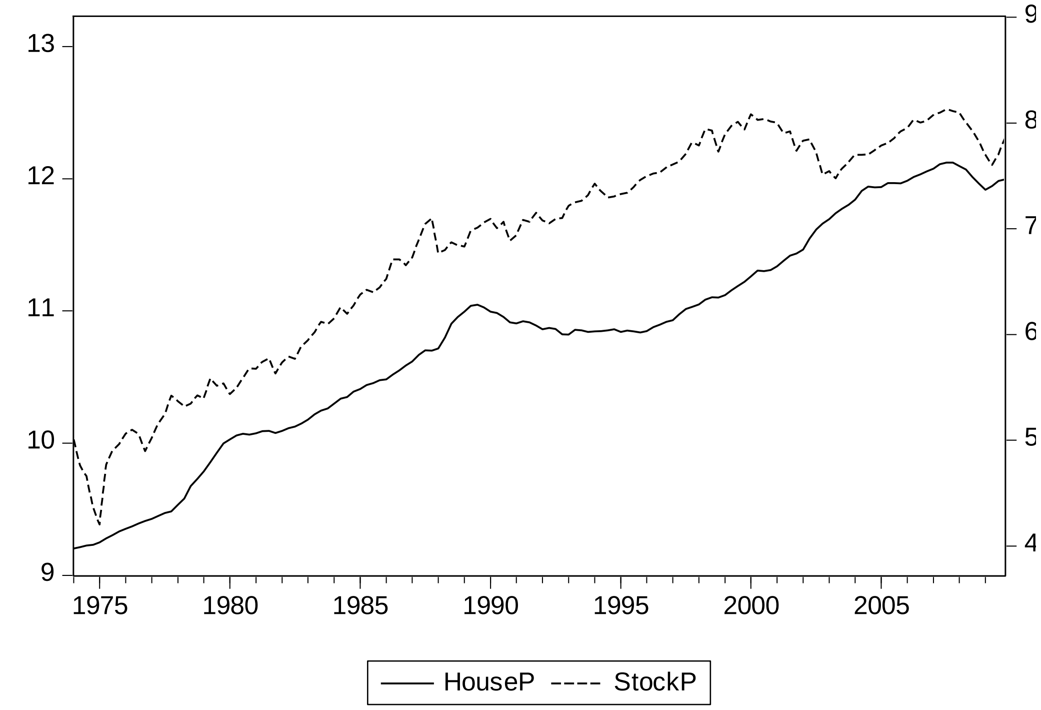
Table 1. Unit Root and Cointegration Tests						
	UK			US		
	Stock Price	House Price	Residual	Stock Price	House Price	Residual
ADF	-1.20	-1.44	-1.62	-0.67	-1.63	-3.01
ESTR	-	-	-3.07*	-	-	-3.36*

Notes: ADF refers to the usual Augmented Dickey-Fuller test of equation (1). The test for stock prices and house prices includes a constant, but not for the cointegrating residual. ESTR refers to the test of exponential smooth-transition behaviour of Kapetanios et al (2006), see equation (2). No constant is included in the test. Lag lengths in the tests were obtained according to the AIC/BIC. * indicates 5% statistical significance, ** indicates 10% significance.

Table 2. Error-Correction Models								
	UK				US			
	Linear		ESTR		Linear		ESTR	
	SP	HP	SP	HP	SP	HP	SP	HP
Constant	0.013 (1.22)	0.006 (3.04)	0.052 (4.90)	0.051 (2.45)	0.006 (0.79)	0.016 (5.91)	0.012 (1.51)	0.015 (5.27)
Lag of SP	0.109 (1.20)	-0.029 (-1.80)	0.152 (1.79)	-0.029 (-1.73)	0.109 (1.35)	0.021 (0.76)	0.144 (1.77)	0.019 (0.67)
Lag of HP	0.255 (0.78)	0.708 (11.36)	0.352 (1.08)	0.702 (11.04)	0.683 (2.89)	-0.266 (-3.15)	0.659 (2.81)	-0.265 (-3.10)
ECT	-0.040 (-1.64)	0.003 (0.73)	0.074 (1.58)	-0.002 (-0.26)	-0.052 (-2.34)	0.005 (0.69)	0.178 (1.16)	-0.009 (-0.16)
ECT- ESTR			-0.381 (-2.74)	0.009 (0.33)			-0.291 (-2.72)	0.017 (0.28)
Q1	0.07	0.57	0.07	0.68	0.002	0.03	0.01	0.03
Notes: The linear refers to the usual linear error-correction model. ESTR refers to the model given in equation (3). The numbers in parentheses are *t*-values. Q1 is a test for first-order autocorrelation.								

Figure 1. House and Stock Price Time Series Plots

UK House and Stock Prices



US House and Stock Prices